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METEOROLOGICAL DATA REPORT

UNGUIDED ROCKET IMPACT DISPERSION AT WHITE SANDS MISSILE RANGE, NEW MEXICO (February 1972)

BY

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ECOM
UNITED STATES ARMY ELECTRONICS COMMAND

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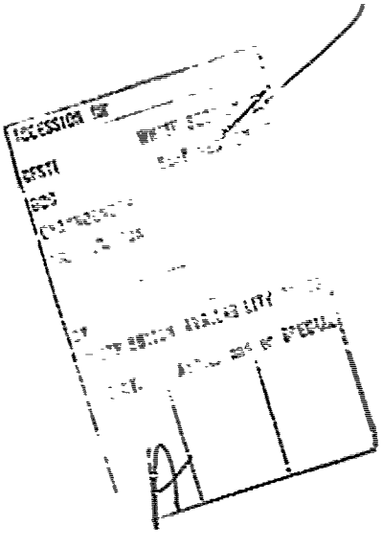

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Impact dispersion data are presented for the following unguided sounding rockets launched from White Sands Missile Range, New Mexico, or the Utah Launch Complex, Green River, Utah, during 1965-1971: Aerobee 350, Aerobee-170, Aerobee-170-A, Aerobee-150, Athena (Second Stage), Athena H (First Stage), Nike-boosted rockets (Hydac, Javelin, Iroquois, Apache, Apache Nicap, Calrom), Met RDT&E, Viper Loki, ARCAS, and Boosted ARCAS (Boosted I, Boosted II, HVAR, Sidewinder, and Sparrow).

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8. Athena H (First Stage)						
9. Nike-boosted Rockets						
10. Met RDT&E Rockets						
11. Viper Loki						
12. ARCAS and Boosted ARCAS						

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DA Task 1T665702D127-02

ATMOSPHERIC SCIENCES LABORATORY
WHITE SANDS MISSILE RANGE, NEW MEXICO

FOREWORD

This report is a revision of Data Report 602, published under the same title in March 1971. The revision updates the original data to cover the period through December 1971 and includes data on new rockets launched at White Sands Missile Range, New Mexico.

ABSTRACT

Impact dispersion data are presented for the following unguided sounding rockets launched from White Sands Missile Range, New Mexico, or the Utah Launch Complex, Green River, Utah, during 1965-1971: Aerobee-350, Aerobee-170, Aerobee-170-A, Aerobee-150, Athena (Second Stage), Athena H (First Stage), Nike-boosted rockets (Hydac, Javelin, Iroquois, Apache, Apache Nicap, Cajun), Met RDT&E, Viper Loki, ARCAS, and Boosted ARCAS (Boosted I, Boosted II, HVAR, Sidewinder, and Sparrow).

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INTRODUCTION

The statistical scatter of the actual impact points about the predicted impact point of an unguided rocket is the rocket's impact dispersion.

The causes of rocket impact dispersion can be divided into five basic categories: 1) variations in atmospheric components, 2) variations in rocket components, 3) rocket misalignments, 4) launcher misalignments, and 5) factors which do not vary but are not precisely evaluated or are unaccounted for.

Before an unguided rocket is flight-tested, a theoretical dispersion study is usually performed to estimate its dispersion. This analysis can be made using a trajectory simulation program in a high-speed computer. The best estimates available of the perturbing factors can be put in the program, and the impact points can be compared with the nominal impact point. When this procedure is used, it is assumed that the perturbing factors act independently.

This report presents the actual impact dispersion of the Aerobee-350, Aerobee-170, Aerobee-170-A, Aerobee-150, Athena (Second Stage), Athena H (First Stage), Nike-boosted rockets, Met RDT&E, Viper Loki, ARCAS, and Boosted ARCAS fired at White Sands Missile Range (WSMR), New Mexico, or the Utah Launch Complex, Green River, Utah, for the period 1965-1971. No attempt is made to isolate the various causes of dispersion.

The actual impact points were taken from surveys when available. Elsewhere, radar or Sonic Observation of Trajectory and Impact of Missiles (SOTIM) impact data were used.

A brief description of each rocket precedes the tabular presentation of its impact dispersion.

This information should be helpful for range planning and safety considerations.

AEROBEE-350

The Aerobee-350 is a slow acceleration, liquid propellant, fin-stabilized rocket used to carry payloads of 150 to 1000 pounds to altitudes from 150 statute miles (ST. Miles) above mean sea level (MSL) for the heavier payloads to 310 miles for the lighter payloads when launched at WSMR (4,000 feet MSL). A solid propellant booster is used to increase the rocket's exit velocity from a 162-foot tower.

The nominal rocket impact range is 50 statute miles, although this may vary, depending on the wind situation and project requirements.

A meteorological real-time system (1-3) in which wind data from the launch site are transmitted over commercial data lines to a high [illegible] computer at WSMR is used for these firings. The computer r[illegible] the wind data, applies it to a trajectory simulation (4), a[illegible] selects launcher settings using iterative techniques.

There have been only two Aerobee-350 launches to date. Rocket underperformance resulted in greater wind response than expected on the first launch in 1970 and caused Missile Flight Safety to terminate thrust at approximately 42 seconds to prevent off-range impact. The miss distance on the second launch in 1971 was two statute miles.

AEROBEE-170 and AEROBEE-170-A

The Aerobee-170 and 170-A are slow acceleration, liquid propellant, fin-stabilized rockets used to carry payloads of 150 to 550 pounds to altitudes from 85 statute miles MSL for the heavier payloads to 205 miles for the lighter payloads when launched at WSMR (4,000 feet MSL). A solid propellant booster is used to increase the rocket's exit velocity from a 162-foot tower for the 170 and from a 150-foot tower for the 170-A.

The nominal rocket impact range is 50 statute miles, although this may vary, depending on the wind situation and project requirements.

The wind-weighting technique is used for Aerobee-170 and 170-A impact predictions at WSMR.

AEROBEE-170 and AEROBEE-170-A DISPERSION

WHITE SANDS MISSILE RANGE, NEW MEXICO

1958-71

YEAR	*TOTAL FIRINGS	CUMULATIVE MEAN MISS DISTANCE MILES	RELATIVE FREQUENCY DISTRIBUTION OF AEROBEE-170 IMPACT MISS DISTANCES (PER CENT) STATUTE MILES					
			0-5	>5-10	>10-15	>15-20	>20-25	>25-30
1958	1	17.3	0	0	0	100	0	0
1959	7	—	—	—	—	—	—	—
1970	12	12.0	18	28	27	18	0	9
1971	24	11.8	25	27	9	16	9	9
1958-1971	39	12.1	24	26	15	21	6	9

Standard error of estimate for the period of record: 14.2 St. Miles.

* The following Aerobee-170 launches were excluded from this dispersion analysis:

1959 2 malfunctions
1970 1 malfunction
1971 2 malfunctions

AEROBEE-150

The Aerobee-150 is a slow acceleration, liquid propellant, fin-stabilized rocket used to carry payloads of 150 to 500 pounds to altitudes from 75 statute miles MSL for the heavier payloads to 190 miles for the lighter payloads when launched at WSMR (4,000 feet MSL). A solid propellant booster is used to increase the rocket's exit velocity from a 15'-foot tower.

The nominal rocket impact range is 50 statute miles, although this may vary, depending on the wind situation and project requirements.

The wind-weighting technique is used for Aerobee-150 impact predictions at WSMR.

AEROBEE-150 DISPERSION

WHITE SANDS MISSILE RANGE, NEW MEXICO

1965-71

YEAR	*TOTAL FIRINGS	CUMULATIVE MEAN MISS STATUTE MILES	RELATIVE FREQUENCY DISTRIBUTION OF AEROBEE-150 IMPACT MISS DISTANCES (PER CENT) STATUTE MILES					
			0≤5	>5≤10	>10≤15	>15≤20	>20≤25	>25≤30
1965	42	11.1	10	48	15	13	10	5
1966	37	9.7	12	47	24	18	0	0
1967	42	8.7	31	33	26	7	0	2
1968	45	9.2	28	30	30	5	5	3
1969	36	8.4	25	36	31	8	0	0
1970	21	8.8	29	33	24	10	0	4
1971	15	7.8	27	40	27	6	0	0
1965-1971	238	9.3	22	38	25	10	3	2

Standard error of estimate for the period of record: 10.7 ST. Miles.

* The following Aerobee-150 launches were excluded from this dispersion analysis:

1965 2 malfunctions
1966 3 malfunctions
1968 3 malfunctions; 2 dummy payload rail launches

ATHENA (SECOND STAGE) AND ATHENA H (FIRST STAGE)

The Athena is a multi-staged, fin-stabilized rocket fired from a zero-length launcher at Green River, Utah, to impact on WSMR. The first two stages of the regular Athena are unguided and require impact predictions. Since the second stage is most wind sensitive, its impact dispersion is presented. Only the first stage of the Athena H is unguided and requires impact predictions. There have been two Athena H launches to date and their miss distances were 16 and 31 statute miles.

A meteorological real-time system (1-3) in which wind data from the launch site are transmitted over commercial data lines to a high-speed computer at WSMR is used for these firings. The computer reduces the wind data, applies it to a trajectory simulation (4), and selects launcher settings using iterative techniques.

The peak altitude for the first stage of the Athena H and for the second stage of the regular Athena varies from 135 to 175 statute miles MSL. The nominal impact range is approximately 455 statute miles.

ATHENA (SECOND STAGE) DISPERSION

WHITE SANDS MISSILE RANGE, NEW MEXICO

1966-71

YEAR	*TOTAL FIRINGS	CUMULATIVE MEAN MISS STATUTE MILES	RELATIVE FREQUENCY DISTRIBUTION OF ATHENA IMPACT MISS DISTANCES (PER CENT) STATUTE MILES							
			0≤5	>5≤10	>10≤15	>15≤20	>20≤25	>25≤30	>30≤ 5	>35≤40
1966	28	12.8	7	41	19	15	15	4	0	0
1967	30	11.6	17	28	28	17	7	3	0	0
1968	16	13.7	13	44	6	6	25	0	0	6
1969	11	10.5	0	64	18	9	0	9	0	0
1970	2	10.9	0	0	100	0	0	0	0	0
1971	8	12.6	0	38	38	12	12	0	0	0
1966-1971	95	12.3	10	39	22	13	12	3	0	1

Standard error of estimate for the period of record: 14.1 ST. Miles

* Two Athena launches were excluded from this dispersion analysis:
9 June 1966; unknown impact
9 February 1967; second stage malfunction

NIKE-BOOSTED ROCKETS

The Nike-boosted rockets were combined in this analysis since they all showed similar impact dispersion characteristics.

Each Nike-boosted rocket utilizes a Nike M-5 booster which gives the second stage an initial impulse so that it coasts to an altitude of from 35,000 to 50,000 feet MSL prior to second-stage ignition.

The second-stage motors are, in order of higher performance: Hydac, Javelin, Iroquois, Apache, and Cajun.

The Nike-Hydac carries a 220-pound payload to approximately 135 statuts miles MSL; the Nike-Javelin carries a 150-pound payload to approximately 120 miles MSL; the Nike-Iroquois carries a 70-pound payload to approximately 175 miles MSL; the Nike-Apache carries a 70-pound payload to approximately 135 miles MSL; and the Nike-Cajun carries a 70-pound payload to approximately 95 miles MSL.

Although all Nike-boosted rockets were combined for the overall dispersion analysis, a table showing impact data for the individual firings appears in Appendix A.

The nominal impact range for Nike-boosted rockets at WSMR varies from 50 to [illegible] statute miles.

The wind-weighting technique is used for impact predictions of Nike-boosted rockets fired at WSMR.

DISPERSION OF NIKE-BOOSTED ROCKETS**

WHITE SANDS MISSILE RANGE, NEW MEXICO

1966-71

YEAR	*TOTAL FIRINGS	CUMULATIVE MEAN MISS STATUTE MILES	RELATIVE FREQUENCY DISTRIBUTION OF NIKE BOOSTED ROCKET IMPACT MISS DISTANCES (PER CENT) STATUTE MILES							
			0≤5	>5≤10	>10≤15	>15≤20	>20≤25	>25≤30	>30≤35	>35≤40
1966	52	11.8	20	31	16	18	8	2	4	0
1967	41	13.2	17	19	31	14	8	8	0	3
1968	18	10.4	35	18	18	18	12	0	0	0
1969	23	11.2	17	31	26	13	13	0	0	0
1970	18	6.1	43	43	14	0	0	0	0	0
1971	15	8.2	37	37	16	5	5	0	0	0
1966-1971	171	10.9	25	28	21	17	8	3	1	1

Standard error of estimate for the period of record: 13.3 ST. Miles

* The following Nike-boosted launches were excluded from this dispersion analysis:

1966 3 malfunctions
1967 5 malfunctions
1968 1 malfunction
1970 4 malfunctions

** Nike-Hydac, Nike-Javelin, Nike-Iroquoie, Nike Apache, Nike-Apache Nicap, Nike Cajun.

MET RDT&E ROCKETS

The Meteorological Research, Development, Test, and Evaluation (MET RDT&E) rocket is a single-stage, fin-stabilized, solid propellant rocket used to carry a 7 to 10-pound payload to approximately 45 statute miles MSL when launched at WSMR (4,000 feet MSL). The MET RDT&E is fired from a boxed rail launcher.

The nominal rocket impact range is approximately 39 statute miles at WSMR.

The wind-weighting technique is used for MET RDT&E impact predictions at WSMR.

MET RDT&E ROCKET DISPERSION

WHITE SANDS MISSILE RANGE, NEW MEXICO

1969-71

YEAR	*TOTAL FIRINGS	CUMULATIVE MEAN MISS STATUTE MILES	RELATIVE FREQUENCY DISTRIBUTION OF RDT&E IMPACT MISS DISTANCES (PER CENT) STATUTE MILES					
			0≤5	>5≤10	>10≤15	>15≤20	>20≤25	>25≤30
1969	6	8.6	67	0	0	17	16	0
1970	52	8.7	29	42	21	3	0	5
1971	18	10.6	6	41	41	12	0	0
1969-1971	76	9.2	26	38	25	7	1	3

Standard error of estimate for the period of record: 10.8 ST. Miles.

* The following RDT&E launches were excluded from this dispersion analysis:

1970 10 malfunctions; 4 unknown impacts
1971 ---------- 1 unknown impact

VIPER LOKI

The Viper Loki is a two-staged, fin-stabilized, solid propellant meteorological rocket used to carry a 110-gram (0.24 pound) payload to approximately 80 statute miles MSL when launched at WSMR (4,000 feet MSL). The Viper Loki is fired from a rail launcher.

The nominal rocket impact range is approximately 30 statute miles at WSMR.

The wind-weighting technique is used for Viper Loki impact predictions at WSMR.

VIPER LOKI DISPERSION

WHITE SANDS MISSILE RANGE, NEW MEXICO

1969-71

YEAR	*TOTAL FIRINGS	CUMULATIVE MEAN MISS STATUTE MILES	RELATIVE FREQUENCY DISTRIBUTION OF VIPER LOKI IMPACT MISS DISTANCES (PER CENT) STATUTE MILES				
			0≤5	>5≤10	>10≤15	>15≤20	>20≤25
1969	16	11.8	0	60	0	40	0
1970	22	10.7	11	34	33	22	0
1971	21	7.5	32	37	31	0	0
1969-1971	59	9.0	21	40	27	12	0

Standard error of estimate for the period of record: 10.1 ST. Miles

* The following Viper Loki launches were excluded from this dispersion analysis:

1969 7 malfunctions; 4 unknown impacts
1970 1 malfunction ; 12 unknown impacts
1971 ---------- 2 unknown impacts

ARCAS AND BOOSTED ARCAS

The ARCAS is an end-burning, slow acceleration, fin-stabilized, meteorological rocket used to carry a 6.5-pound payload to approximately 45 statute miles MSL.

A gas-generator is used to increase the exit velocity of the rocket from an 18-foot launch tube.

The nominal rocket impact range at WSMR is approximately 35 statute miles for the ARCAS and 50 miles for the Boosted ARCAS

Various motors have been used as boosters for the ARCAS to increase its altitude capability. Boosters used with the ARCAS at WSMR have been the HVAR, MARC 14A1 (Boosted ARCAS I), Sidewinder, MARC 42A1 (Boosted ARCAS II), and the Sparrow. The peak altitude for a HVAR-boosted ARCAS with a 12-pound payload is approximately 57 statute miles MSL, while the MARC 14A1 will reach approximately 63 miles. The Sidewinder-boosted ARCAS will reach approximately 85 miles, and the MARC 42A1 and Sparrow-boosted ARCAS will reach approximately 105 miles with similar payloads.

At WSMR, the boosted ARCAS is launched from a 15-foot rail.

The wind-weighting technique is used for the ARCAS and Boosted ARCAS predictions at WSMR.

ARCAS (GAS GENERATED) DISPERSION

WHITE SANDS MISSILE RANGE, NEW MEXICO

1967-71

YEAR	*TOTAL FIRINGS	CUMULATIVE MEAN MISS STATUTE MILES	RELATIVE FREQUENCY DISTRIBUTION OF ARCAS IMPACT MISS DISTANCES (PER CENT) STATUTE MILES				
			0≤5	>5≤10	>10≤15	>15≤20	>20≤25
1967	123	6.2	41	43	15	0	1
1968	126	7.7	25	51	21	4	0
1969	128	7.3	39	38	17	5	1
1970	101	6.5	44	41	10	5	0
1971	63	5.8	53	36	9	2	0
1967-1971	541	6.8	40	42	15	3	0

Standard error of estimate for the period of record: 7.4 ST. Miles

* The following ARCAS launches were excluded from this dispersion analysis:

1967	4 malfunctions;	6 unknown impacts
1968	17 malfunctions;	8 unknown impacts
1969	7 malfunctions;	4 standard ARCAS
1970	14 malfunctions;	2 unknown impacts
1971	7 malfunctions;	1 unknown impact

BOOSTED ARCAS** DISPERSION

WHITE SANDS MISSILE RANGE, NEW MEXICO

1968-71

YEAR	*TOTAL FIRINGS	CUMULATIVE MEAN MISS STATUTE MILES	RELATIVE FREQUENCY DISTRIBUTION OF BOOSTED ARCAS IMPACT MISS DISTANCES (PER CENT) STATUTE MILES				
			0-5	5-10	10-15	15-20	20-25
1968	5	5.8	67	33	0	0	0
1969	10	12.2	0	50	25	0	25
1970	7	9.4	43	14	29	0	14
1971	9	10.5	29	29	0	29	14
1968-1971	31	9.8	33	29	14	10	14

Standard error of estimate for the period of record: 11.7 St. Miles

* The following Boosted ARCAS launches were excluded from this dispersion analysis:

1968 1 malfunction; 1 unknown impact
1969 - malfunctions; 2 unknown impacts
1971 2 malfunctions

** Sparrow, MARC 4-DAI (Boosted ARCAS II), Sidewinder, MARC 1-4A1 (Boosted ARCAS I), EVAR.

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APPENDIX A

DISPERSION DATA

FOR

INDIVIDUAL NIKE-BOOSTED

ROCKET FIRINGS

NIKE-APACHE

1966-1971

YEAR	MISSILE	DATE	TIME	PAYLOAD lbs.	PREDICTED* 2nd Stage Impact		ACTUAL* 2nd Stage Impact		MISS*
1971	DRS NASA 14.388	12 Mar	1750M	187.0	80.0N	9.0W	60.1N	4.0W	20.5
	NASA 14.465	22 Apr	1816M	185.0	73.0N	0.0	67.4N	2.6W	6.2
	NASA 14.467	22 Apr	1847M	156.0	38.0N	8.0W	31.2N	10.8W	7.4
1970	NASA 14.413 UG	27 Jun	0145M	110	48.0N	5.0W	42.0N	6.8W	6.3
	NASA 14.413	27 Aug	2143M	110	53.6N	9.7W	49.3N	13.1W	5.5
	NASA 14.464 UA	21 Sept	2200M	140	50.0N	6.0W	---	---	Malfunction
	NASA 14.458	20 Nov	1200M	100	45.0N	7.0W	---	---	Malfunction
	NASA 14.418	17 Dec	1223M	160	50.0N	7.0W	54.0N	3.2W	5.5
1969	DRS NASA 14.420	28 May	1448M	115	50.0N	1.7E	51.0N	4.0E	2.5
	STV85	29 May	0755M	71	70.0N	2.4W	65.0N	14.9W	13.5

* These figures are presented in ST. Miles

NIKE-APACHE (CONT)

1966-1971

YEAR	MISSILE	DATE	TIME	PAYLOAD lbs.	PREDICTED* 2nd Stage Impact		ACTUAL* 2nd Stage Impact		MISS*
1969	DRS 14.421	9 Jun	1000M	115	49.9N	3.1E	65.2N	6.7W	18.2
	STV87	1 July	0639M	71	69.8N	4.9W	57.4N	5.1W	12.4
	DRS NASA 14.422	13 Aug	0030M	133.5	50.0N	2.2W	56.2N	7.1E	11.2
	DRS NASA 14.423 UA	22 Aug	0435M	133.5	50.2N	5.3W	50.3N	1.9W	3.4
	NASA 14.353 UG	4 Dec	1831M	129.5	49.5N	7.4W	44.2N	1.0W	8.3

* These figures are presented in ST. Miles

NIKE-APACHE (CONT)

1966-1971

YEAR	MISSILE	DATE	TIME	PAYLOAD lbs.	PREDICTED* 2nd Stage Impact		ACTUAL* 2nd Stage Impact		MISS*
1968	Speedball II R119 SN 53	2 Feb	1657M	92	49.8S	18.1E	38.5S	12.9E	12.4
	STV070 SN302	27 Feb	1054M	71	46.0S	9.8E	49.6S	6.1W	16.3
	Speedball II R121 SN54	25 Apr	1006M	85	44.2S	18.0E	44.0S	1.0E	17.0
	Speedball II R122 SN 55	8 May	1025M	85	49.8S	18.1E	59.3S	0.0	20.4
	DRS NASA 14.363 GT	4 Jun	1037M	150	50.0N	1.7W	41.3N	5.6W	9.5
	DRS NASA 14.335 GT	10 Jun	1115M	116.5	49.8N	4.4W	52.1N	4.2W	2.3
	DRS NASA 14.336 UA	22 Aug	0238M	115	50.0N	1.7W	49.6N	1.7W	0.4
	DRS NASA 14.301 UA	20 Aug	1332M	115	50.0N	1.7W	52.6N	12.4E	14.3
	DRS NASA 14.352 UA	4 Dec	1111M	115	49.9N	2.6W	53.8N	3.0W	3.9
	DRS NASA 14.353 UA	14 Dec	0810M	115	50.0N	0.0	57.1N	4.0W	8.1
1967	Speedball R096 SN 42	11 Jan	1022M	92	39.0S	18.2E	45.2S	8.8E	11.3

* These figures are presented in St. Miles

NIKE-APACHE (CONT)

1966-1971

YEAR	MISSILE	DATE	TIME	PAYLOAD lbs.	PREDICTED* 2nd Stage Impact		ACTUAL* 2nd Stage Impact		MISS*
1967	Speedball R097 SN 43	16 Feb	1323M	45	39.0S	18.2E	45.2S	36.7E	19.5
	Speedball R098 SN 44	21 Feb	1404M	75	49.8S	18.1E	47.6S	7.1E	11.2
	Speedball II R099 SN 45	2 May	1145M	79.5	44.5S	18.0E	44.3S	11.6E	6.4
	Speedball II R100 SN 96	17 May	0900M	60.0	48.9S	17.8E	37.6S	1.9E	11.5
	Speedball II R101 SN 47	24 May	1110M	77.5	47.2S	19.9E	53.5S	0.7W	21.5
	Speedball II R102 SN 48	5 July	1533M	71	49.8S	18.1E	64.7S	1.9E	22.0
	STV SR 57	7 July	0853M	71	43.9S	10.1E	41.5S	5.8W	16.1
	Speedball II R103 SN 51	26 July	1010M	60	49.8S	18.1E	18.1S	1.6E	Malfunction
	Speedball II R104 SN 50	26 July	1200M	88	49.8S	18.1E	51.9S	8.2E	10.1
	Speedball II R105 SN 49	1 Aug	1325M	68	44.5S	18.0E	39.9S	27.6E	10.6
	Speedball II R106 SN 47	7 Aug	1434M	55	49.8S	18.1E	2.4S	3.9E	Malfunction

* These figures are presented in ST. Miles

NIKE-APACHE (CONT)

1966-1971

YEAR	MISSILE	DATE	TIME	PAYLOAD lbs.	PREDICTED* 2nd Stage	Impact	ACTUAL* 2nd Stage	Impact	MISS*
1967	DRS NASA 14.343 GT	4 Aug	2000M	115	43.8N	3.1W	54.1N	0.7E	11.0
	Speedball II R107 SN43	9 Aug	1406M	68	49.8S	18.1E	55.4S	22.3E	7.0
	Speedball II R108 SN52	22 Aug	1337M	60	49.8S	18.1E	46.5S	1.6E	16.8
	Speedball II R109 SN44	12 Sept	1826M	80	49.8S	18.1E	50.2S	13.8E	4.3
	Speedball II R110 SN45	19 Sept	1253M	80	49.9S	18.1E	41.2S	6.1E	Malfunction
	Speedball II R111 SN46	[illegible] Sept	1100M	80	42.3S	18.0E	44.1S	14.8E	3.7
	Speedball II R112 SN37	22 Sept	1430M	80	49.8S	18.1E	46.9S	21.6E	4.[illegible]
	Speedball II R113 SN48	25 Sept	1156M	57	49.8S	18.1E	49.2S	15.3E	2.9
	Speedball II R114 SN49	[illegible] Sept	1600M	57	[illegible]	18.1[illegible]	59.9S	14.1E	[illegible].1
	Speedball II [illegible]	26 Sept	[illegible]	[illegible]	[illegible]	18.7E	45.2S	11.2W	29.9

* [illegible] Miles

NIKE-APACHE (CONT)

1966-1971

YEAR	MISSILE	DATE	TIME	PAYLOAD lbs.	PREDICTED* 2nd Stage Impact		ACTUAL* 2nd Stage Impact		MISS*
1967	Speedball II R116 SN51	26 Sept	1430M	78	49.8S	18.1E	52.0S	28.8E	10.9
1966	STV SRO22	18 Jan	1506M	55	64.0N	0.0	61.0N	24.2E	24.4
	STV SRO23	24 Jan	1304M	55	63.8N	5.6W	73.0N	10.5E	18.5
	STV SRO24	11 Mar	1200M	76.5	49.8N	4.3W	32.5N	13.5W	19.6
	STV SRO25	11 Mar	1402M	70	[illegible]N	5.6W	3.3N	1.0E	Malfunction
	STV SRO26	29 Mar	1214M	70	69.7N	6.1W	68.1N	12.0W	6.1
	STV SRO27	21 Apr	1145M	70.3	70.0N	0.0	78.3N	15.6W	17.7
	STV SRO28	21 Apr	1403M	70	70.0N	0.0	77.9N	13.7W	15.8
	STV SRO29	2 May	0826M	80	59.8N	5.2W	53.2N	24.0W	19.9
	STV SRO30	2 May	1047M	80	59.8N	5.2W	41.7N	10.7E	24.1
	STV SRO31	24 May	1600M	74.8	69.0N	3.7W	95.4N	18.2E	33.6
	STV SRO32	2 Jun	1043M	74.8	69.7N	6.1W	5.8N	1.5W	Malfunction
	Photometric SRO33	7 Jun	0344M	68.5	68.4N	3.6W	67.4N	10.0W	6.4

* These figures are presented in ST. Miles

NIKE-APACHE (CONT)

1966-1971

YEAR	MISSILE	DATE	TIME	PAYLOAD lbs.	PREDICTED* 2nd Stage Impact		ACTUAL* 2nd Stage Impact		MISS*
1966	Photometrl. SR034	13 Jun	0344M	68.5	59.8N	5.2W	65.7N	10.4W	7.9
	STV SR036	28 July	1100M	81	69.7N	8.7W	71.3N	7.9W	1.8
	ERDA 66-24	1 Aug	0100M	65	65.7N	5.8W	67.0N	8.3E	14.2
	ERDA 66-25	1 Aug	0306M	65	71.7N	6.3W	12.3N	5.8W	Malfunction
	ERDA 66-26	1 Aug	0600M	65	79.7N	7.0W	88.9N	6.2W	9.2
	ERDA 66-22	1 Aug	1211M	68	69.9N	6.1W	70.7N	6.0W	0.8
	ERDA 66-23	1 Aug	1505M	68	59.8N	5.2W	66.0N	5.1E	12.0
	Speedball 11 887 SN33	3 Aug	1100M	65	49.8S	18.1E	33.6S	12.9E	17.0
	STV SR035	4 Aug	0330M	111.5	54.8N	4.8W	49.1N	4.0W	5.8
	ORS NASA 14.179 UA	15 Aug	1435M	115	52.3N	4.6W	57.6N	2.1W	5.9
	STV SR038	30 Aug	0830M	83	69.9N	4.3W	56.3N	8.9W	14.3
	STV SR037	9 Sept	0900M	73.5	69.7N	6.1W	4.6N	11.2W	7.1

* Range figures are presented in n. miles

NIKE-APACHE (CONT)

1966-1971

YEAR	MISSILE	DATE	TIME	PAYLOAD lbs.	PREDICTED* 2nd Stage Impact		ACTUAL* 2nd Stage Impact		MISS*
1966	Speedball II R88 SN34	9 Sept	1450M	83.8	49.8S	18.1E	60.5S	34.9E	19.9
	Speedball II R089 SN35	28 Sept	1120M	65	49.8S	18.1E	47.5S	10.0E	8.4
	Speedball II R090 SN36	5 Oct	1404M	65	49.8S	18.1E	72.3S	18.0E	22.5
	Speedball II R091 SN37	12 Oct	1048M	80	49.8S	18.1E	58.6S	13.0E	10.2
	Speedball II R092 SN38	12 Oct	1341M	80	49.8S	18.1E	61.7S	25.8E	14.2
	DRS NASA 14.299 UA	18 Nov	1515M	115	48.4N	3.4W	68.5N	0.0	20.4
	Speedball II R093 SN39	18 Nov	1400M	45	39.0S	18.2E	37.1S	20.6E	3.1
	Speedball II R094 SN40	18 Nov	1600M	45	36.9N	16.2E	20.3S	14.4E	16.7
	Speedball II R095 SN41	18 Nov	1800M	45	39.0S	18.2E	45.5S	20.3E	6.8

* These figures are presented in ST. Miles

NIKE-HYDAC

1966-1971

YEAR	MISSILE	DATE	TIME	PAYLOAD lbs.	PREDICTED* 2nd Stage Impact		ACTUAL* 2nd Stage Impact		MISS*
1971	BE-01 IEO	20 May	1200M	285	71.0N	8.0W	80.5N	2.5E	14.2
1970	STV 92	12 Mar	1422M	220	70.4N	9.3W	78.7N	14.1W	9.6
	STV 93	5 May	0800M	225	69.3N	9.7W	66.6N	10.0W	2.7
	STV 94	5 May	1100M	264	69.3N	9.7W	73.5N	10.9W	4.4
	STV 95	10 Aug	1119M	225	70.6N	7.4W	74.6N	9.4W	4.5
	STV 96	28 Aug	2200M	285	70.0N	1.7W	69.7N	7.2W	3.5
1969	STV 75 SR06	14 Jan	0630M	215	69.0N	2.4W	90.5N	7.0W	22.0
	STV 82	4 Feb	0811M	305	69.9N	3.7W	62.5N	15.4W	15.8
	STV 83	4 Feb	0900M	220	68.9N	12.2W	63.8N	0.7E	14.1
	STV 84	27 Feb	0914M	220	73.9N	13.0W	81.8N	15.8W	8.4
	STV 86	4 Jun	1002M	210	70.0N	2.4W	62.0N	2.5W	8.0
	STV 88	10 July	1130M	210	70.0N	0.0	70.0N	10.5W	10.5

* These figures are rounded to the nearest Miles

NIKE-HYDAC (CONT)

1966-1971

YEAR	MISSILE	DATE	TIME	PAYLOAD lbs.	PREDICTED* 2nd Stage Impact		ACTUAL* 2nd Stage Impact		MISS*
1969	Ballistic Round	10 July	1230M	225	70.0N	0.0	69.1N	5.2E	5.3
	STV 89	30 July	1055M	210	69.9N	3.7W	74.7N	28.1W	24.9
	Ballistic Round	30 July	1145M	225	69.9N	3.7W	55.6N	19.4W	21.2
	STV 90	24 Sept	1911M	254	69.3N	8.5W	75.4N	9.4W	6.0
	STV 91	22 Oct	1112M	264	74.4N	9.1W	80.9N	11.4W	6.9
1968	STV SR071	12 Aug	0614M	218	60.0N	0.0	59.9N	12.5W	12.5
	STV SR072	4 Sept	0805M	210	69.9N	3.1W	82.2N	15.5W	17.5
	STV SR073	5 Sept	0800M	218	69.9N	3.7W	72.9N	3.8W	3.0
	STV SR074	5 Sept	0800M	218	69.9N	3.7W	70.6N	6.4W	2.8
	STV SR076	10 Oct	0630M	223	69.9N	3.7W	81.2N	22.8E	Malfunction
	95-68-4-604	17 Oct	1530M	400	44.6N	2.3W	42.6N	5.5W	3.8
	95-68-5-604	22 Oct	0900M	400	61.3N	3.2W	65.0N	11.3W	8.9
	STV SR077	24 Oct	0703M	217	71.0N	2.5W	89.6N	17.3W	23.0

* These figures are presented in ST. Miles

NIKE-HYDAC (CONT)

1966-1971

YEAR	MISSILE	DATE	TIME	PAYLOAD lbs.	PREDICTED* 2nd Stage Impact		ACTUAL* 2nd Stage Impact		MISS*
1967	STV SR045	5 Jan	0900M	233	68.6N	3.0W	64.5N	7.5W	6.1
	STV SR046	24 Jan	1100M	233	58.0N	1.0W	44.8N	3.9W	13.6
	STV SR047	24 Jan	1329M	233	70.0N	2.0W	90.9N	12.8W	25.6
	STV SR048	28 Mar	0933M	233	69.8N	4.9W	69.6N	22.0W	17.1
	DAS STV SR056	24 May	0721M	233	68.7N	2.4W	47.9N	10.1E	24.3
	STV SR058	25 Aug	0135M	268	67.9N	3.6W	67.3N	0.9W	2.7
	SR060 SR602	19 Sept	0041M	270	60.0N	0.0	68.6N	0.0	8.6
	STV SR059	21 Sept	1000M	215	69.0N	0.0	73.1N	3.8W	5.6
	STV SR061	11 Oct	2249M	210	70.0N	0.0	76.1N	19.0W	20.0
	STV SR062	12 Oct	0014M	210	70.0N	1.2E	79.1N	0.4E	9.1
	STV SR069	11 Dec	1436M	215	64.8N	4.5W	98.6N	12.4E	37.8

* These figures are presented in St. Miles

NIKE-HYDAC (CONT)

1966-1971

YEAR	MISSILE	DATE	TIME	PAYLOAD lbs.	PREDICTED* 2nd Stage Impact		ACTUAL* 2nd Stage Impact		MISS*
1966	MK12 STV SR038	20 Sept	0913M	210	69.6N	2.9W	94.0N	26.1W	33.6
	MK12 STV SR039	27 Sept	0835M	210	69.9N	2.9W	79.7N	11.1W	12.8
	STV SR040	4 Oct	0802M	233	69.9N	2.9W	66.5N	2.5W	3.4
	STV SR041	25 Oct	1320M	253	69.9N	2.9W	67.9N	4.2W	2.4
	MK12 STV SR042	15 Nov	0843M	233	69.9N	2.4W	80.4N	1.7W	10.5
	STV SR043	22 Nov	0902M	233	69.9N	3.1W	79.5N	37.4W	26.1
	STV SR044	1 Dec	0823M	233	69.9N	2.9W	83.3N	5.5W	13.7

* These figures are presented in NT. Miles

NIKE-APACHE NICAP

1967

YEAR	MISSILE	DATE	TIME	PAYLOAD lbs.	PREDICTED* 2nd Stage Impact		ACTUAL* 2nd Stage Impact		MISS*
1967	RO-67-1	23 Jan	0001M	65	61.8N	5.4W	38.4N	6.8E	Malfunction
	RO-67-2	23 Jan	0300M	65	59.8N	5.2W	67.4N	4.7W	7.6
	RO-67-3	23 Jan	0600M	65	64.8N	5.7W	16.9N	1.5E	Malfunction
	RO-67-4	23 Jan	1224M	65	59.8N	5.2W	82.2N	6.8E	25.4
	RO-67-5	26 Jan	1145M	65	75.8N	5.3W	87.8N	6.1W	12.0

NIKE-CAJUN

1966-1971

1971	Nike-Cajun DRS	12 Jan	1930M	110	50.0N	6.0W	38.0N	1.3E	14.0
	Sphere Ejection NASA 10.279	25 Mar	0947M	150	50.0N	5.0W	33.5N	13.2W	8.9
	Nike-Cajun 10.278 NA	11 May	2245M	111	44.0N	6.0W	38.1N	6.3W	3.9
	Nike-Cajun 10.280 NA	12 May	1910M	111	44.1N	7.1W	46.5N	10.1W	4.9

* These figures are presented in ST. Miles

NIKE-CAJUN (CONT)

1966-1971

YEAR	MISSILE	DATE	TIME	PAYLOAD lbs.	PREDICTED* 2nd Stage Impact		ACTUAL* 2nd Stage Impact		MISS*
1971	3 Sphere Ejection-6	21 July	1145M	128	50.0	5.0W	43.7N	4.7W	6.3
	3 Sphere Ejection-7	7 Sep	1400M	130	50.0N	5.0W	45.0N	10.0W	7.1
	3 Sphere Ejection	22 Sep	1030M	127	50.0N	5.0W	48.6N	11.9W	7.0
	NASA 10.378	13 Oct	1316M	230	16.0N	5.8W	19.8N	3.4W	4.5
	NASA 10.379	13 Oct	1328M	210	33.0N	8.8W	40.6N	7.0W	7.8
1970	NASA 10.277 NA	20 Mar	1650M	110	49.0N	5.0W	---	---	Malfunction
	3 Sphere Ejection	9 Mar	1246M	132	54.8N	4.8W	48.8N	2.0W	6.6
	3 Sphere Ejection	23 July	1130M	100	49.9N	2.7W	53.6N	3.5W	3.8
	Chemical Trail	5 Oct	2000M	60	59.7N	6.3W	60.1N	10.7W	4.4
	Chemical Trail	5 Oct	2200M	60	59.7N	6.3W	59.5N	4.4E	10.7

* These figures are presented in ST. Miles

NIKE-CAJUN (CONT)

1966-1971

YEAR	MISSILE	DATE	TIME	PAYLOAD lbs.	PREDICTED* 2nd Stage Impact		ACTUAL* 2nd Stage Impact		MISS*
1970	Chemical Trail	6 Oct	2000M	60	59.7N	6.3W	60.3N	17.3W	11.0
	Chemical Trail	6 Oct	2200M	60	---	---	---	---	Malfunction
1969	3 Sphere Ejection	20 Nov	1319M	60	49.9N	4.0W	51.0N	2.0W	2.3
	3 Sphere Ejection	12 Dec	1900M	60	55.9N	2.9W	60.0N	5.2W	4.7
1966	RN 026	22 Apr	1910M	110	65.8N	2.3W	71.1N	0.0	5.8
	NICAP/1	7 July	0438M	110	62.2N	7.7W	62.3N	1.9W	5.8
	NICAP/1	15 July	1309M	110	65.6N	3.4W	65.7N	11.6E	15.0
	NICAP/1	18 July	1540M	110	60.3N	3.2W	55.5N	1.1E	6.4
	NICAP/1	24 July	0005M	110	58.5N	4.6W	56.8N	6.7W	2.7
	NICAP/1	24 July	0130M	110	58.5N	4.6W	63.3N	4.9W	4.8
	NICAP/1	24 July	0300M	110	58.5N	4.6W	67.5N	0.2W	10.0
	NICAP/1	24 July	0430M	110	58.5N	4.6W	64.8N	5.2W	6.3

* These figures are presented in St. Miles

NIKE-CAJUN (CONT)

1966-1971

YEAR	MISSILE	DATE	TIME	PAYLOAD lbs.	PREDICTED* 2nd Stage Impact		ACTUAL 2nd Stage Impact		MISS*
1966	NICAP/1	24 July	0545M	110	58.5N	4.6W	60.4N	6.3W	2.5
	NICAP/1	24 July	0700M	110	58.5N	4.6E	58.0N	7.3W	2.8
	NASA 10.181A1	25 Oct	1110M	104	5?.5N	0.0	55.0N	0.6W	2.6
	NASA 10.1066M	9 Dec	0400M	249	39.4N	7.0W	34.8N	1.8W	6.9

* These figures are presented in ST. Miles

NIKE-JAVELIN

1967-1970

YEAR	MISSILE	DATE	TIME	PAYLOAD lbs.	PREDICTED* 2nd Stage Impact		ACTUAL* 2nd Stage Impact		MISS*
1970	ECM Round	9 Apr	1116M	207	54.8N	4.8W	59.1N	9.4W	6.3
1969	Pre-Secede 1	5 Sept	1955M	147	69.5N	8.5W	72.1N	0.9W	8.0
	Pre-Secede 2	6 Sept	1952M	147	69.5N	8.5W	61.1N	23.7W	17.4
	Pre-Secede 3	13 Sept	1942M	147	69.4N	9.7W	57.4N	18.9W	15.1
1967	MD-67-9.5-2	14 Sept	1930M	180	70.0N	0.0	80.9N	4.4E	11.8
	MD-67-9.5-3	8 Nov	1541M	180	68.0N	2.4W	62.6N	7.4E	11.2

NIKE-IROQUOIS

1971

1971	AF/AO 7.015-2	8 Jan	1441M	71	58.0N	18.0W	61.0N	21.0W	4.2
	AF/AO 7.016-3	8 Jan	1531M	71	57.0N	10.0W	55.0N	1.5E	11.7
	AF/AO 7.015-3	11 Mar	2212M	71	70.0N	13.0W	71.7N	16.4W	3.8

* These figures are presented in ST. Miles

NIKE-IROQUOIS (CONT)

1971

YEAR	MISSILE	DATE	TIME	PAYLOAD lbs.	PREDICTED* 2nd Stage Impact		ACTUAL* 2nd Stage Impact		MISS*
1971	AF/AO 7.9133	11 Mar	2355M	71	72.0N	15.0W	87.9N	11.7W	16.2
	AF/AO 7.017-1	21 Sept	0230M	150	57.0N	10.0W	56.8N	12.5W	2.5
	AF/AO 7.914-1	27 Sept	0230M	150	57.0N	10.0W	55.7N	13.7W	3.9

* These figures are presented in ST. Miles

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